REVISION OF THE PLANT GENUS *GERANIUM* IN UTAH

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Abstract.— Within the state of Utah are seven species of *Geranium*, two of which are annual. The nature of the caudex and the growth habit have been used to separate the perennial species. These characters are inadequate for separating the species. Better morphological characters, keys, and descriptions are presented.

Two characters used to separate various species of *Geranium* are not effective. One of these characters is "plants somewhat caespitose." Use of this character in keys would lead to plants which are sometimes three feet tall and with the same growth habit of plants considered not caespitose. The other character is the branching or simple nature of the caudex. In herbarium specimens it is usually impossible to see the caudex. In addition, authors vary in the description of the caudex; for example, *G. richardsonii* is described as: "caudex often slightly branched" (Hanks and Small, 1907), "the usually simple caudex" (Jones and Jones, 1943), "plants . . . erect from a simple caudex" (Harrington, 1959). The caudex actually varies from simple to very branched. (VanCott, 1969). These characters illustrate a need for a revision of the genus.

Hanks and Small (1907) treated the known species of North America *Geranium*. In Knuth's (1912) worldwide monograph of the genus the treatment of the North American species was more or less copied from Hanks and Small's work. Jones and Jones (1943) treated the perennial species north of Mexico, and Moore (1943) included one Utah species in his coverage of the Mexican species.

Taxonomic Characters

As mentioned above, the nature of the caudex and the growth habit are poor taxonomic characters. Six taxonomically significant characters are described below. The variations of each of them were measured, assigned numbers, then averaged for each character and plotted on polygonal graphs. (Fig. 1) All observations were made under a dissecting microscope.

Stylodia: These are the branches at the tip of the style column which bear the stigmatic surface. These were first soaked with Pohlstoffe then measured with a standard mm ruler. Only mature flowers were measured. For each species the length was averaged.

Petal pilosity: This is the pubescence on the upper surface of the petals. Three degrees of pilosity were recognized and assigned numbers for comparison. The degree and corresponding numbers are: ¼ of the petal covered = 1; ⅓ of the petal covered = 2; and ½ of the petal covered = 3.

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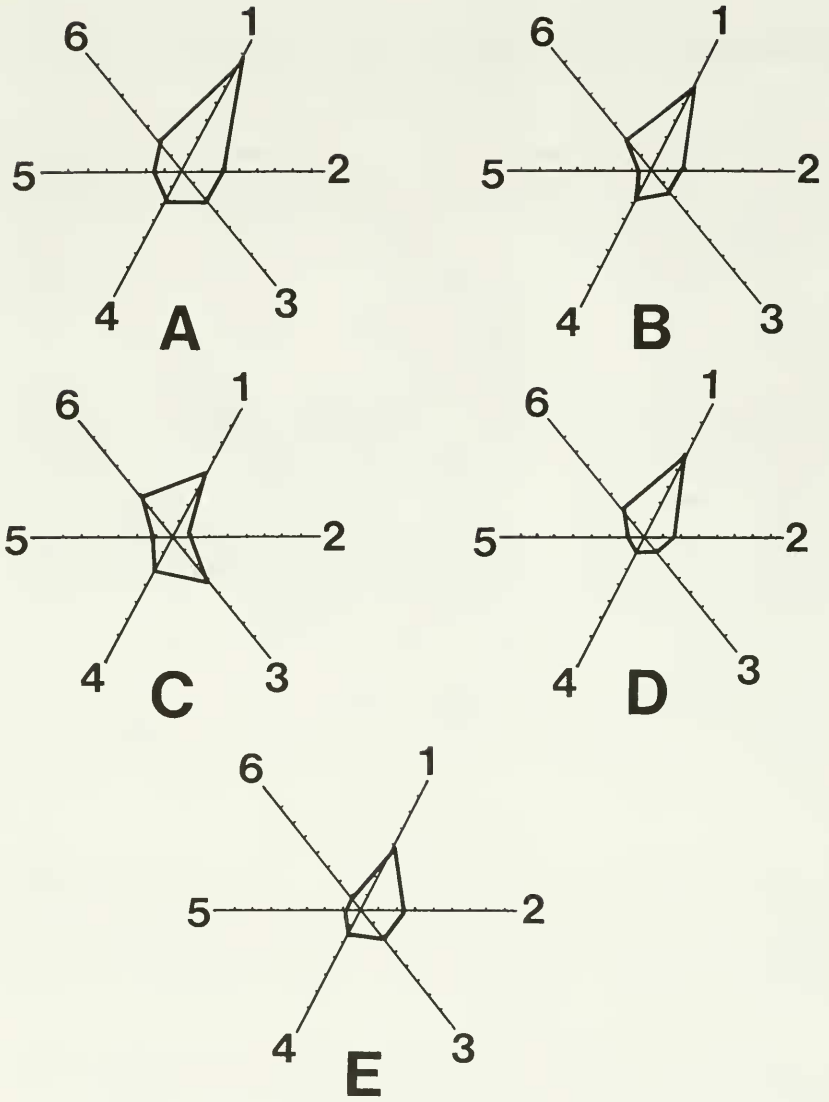

Fig. 1: 1, stylodia; 2, petal pilosity; 3, pubescence of pedicels; 4, pubescence of stems; 5, petals recurving or not; 6, petal color; A, *G. atropurpureum*; B, *G. fremontii*; C, *G. marginale*; D, *G. parryi*; E, *G. richardsonii*.

Pubescence of the pedicels: The pedicels of some species are glandular pubescent, while others are pubescent but not glandular. The color (purple or not) of the glands was also noted. The numbers given these characters are: glandular = 1; purple glands = 2; and nonglandular = 3.

Pubescence of the stems: Pubescence on the stems varied from very glandular to glabrous. The only significant difference in pubescence was glandular = 1; nonglandular = 2.

Petals recurving or not: The petals of most species extend out flat or curve upward slightly. One species has petals that curve downward abruptly. Numbers assigned to these are: petals not recurving = 1; petals recurving = 2.

Petal color: White petals = 1; varying shades of pink to purple = 2.

The above characters have been applied to the five perennial species that occur in the state. The characteristics used to separate the annual species are the number of fertile stamens and awned or nonawned sepals.

Shaw (1952) has worked out the cytology of four species that occur in Utah. The chromosome numbers that he reported are as follows: *G. carolinianum* 2n = 52; *G. pusillum* 2n = 26; *G. richardsonii* n = 26; *G. fremontii* (which he called *G. nervosum*) n = 26. Other cytological work should be done because there are indications of hybridization betweeen *G. richardsonii* and *G. fremontii*.

The probable phylogenetic relationships of the perennial species within the state are outlined on Figure 2 and their distributions are plotted on Figure 3.

Taxonomy

Geranium L. Sp. Pl. 676 (1753)

Annual or perennial herbs, often with a woody caudex; stems glabrous to glandular-villous; leaves palmately lobed, cleft or parted, basal leaves generally larger than the cauline ones; inflorescence compact to spreading; flowers complete, actinomorphic; sepals 5 usually awn tipped; petals 5, deciduous, purple to white, usually pubescent toward the base; ovary 5 lobed, 5 loculed with 2 ovules per locule becoming 1 seeded, elastically recoiling at maturity but not twisting.

Key to the Species

1. Plants annual, petals less than 1 cm long 2
   Plants perennial, petals more than 1 cm long 3

2(1). Sepals awnless, fertile stamens 5 ..... 1. *G. pusillum*
   Sepals awned, fertile stamens 10 ..... 2. *G. carolinianum*

3(1). Plants nonglandular (sometimes nonglandular in *G. richardsonii*) 4
   Portions of the plant glandular 5

4(3). Petals reflexing at maturity, pilose on the petals ⅓-½ their length ..... 3. *G. atropurpureum*
   Petals not reflexing at maturity, pilose on the petals ¼ their length ..... 4. *G. marginale*

5(3). Pedicels and lower portions of the plant glandular ..... 5. *G. parryi*
Lower portions of the plant nonglandular, pedicels glandular 6

6(5). Petals white, petals pilose ⅓-½ their length ..... 6. *G. richardsonii*
Petals purple, petals pilose ¼ their length .... 7. *G. fremontii*

1. *G. pusillum* Burm. f. Sp. Bot. Geran. 27 (1759)

Annual; stems 10-60 cm long, decumbent or prostrate, puberulent; leaves reniform to orbicular, 1-6 cm broad, 3-7 parted; sepals 2.5-5 mm long, awnless; petals purple to violet; 5 fertile stamens; style column 6-9 mm long, glandular puberulent; carpel bodies 2 mm long; seeds smooth. A weed of fields and waste places. Type locality, England and France. Provo Bench near Pleasantview, Utah Co.,

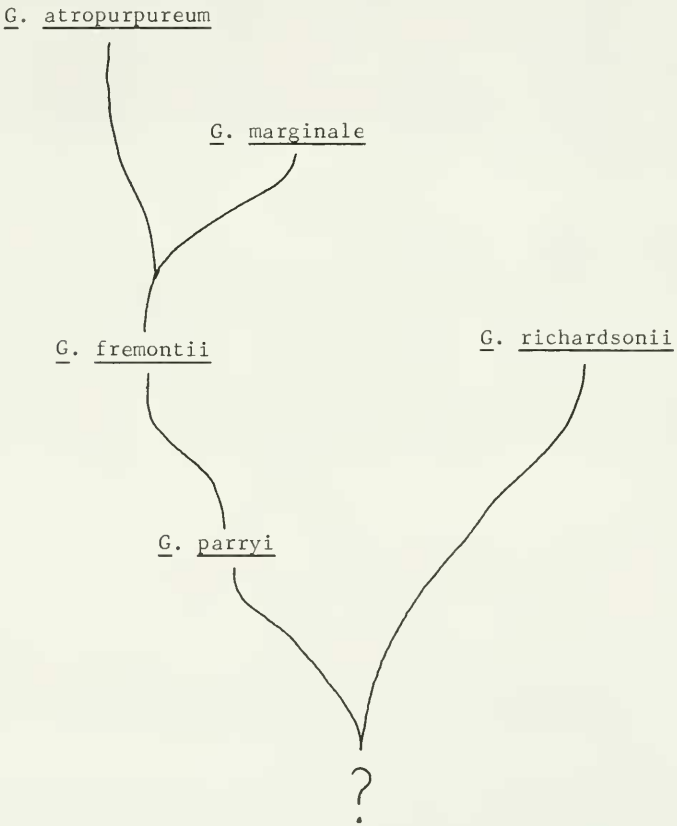

Fig. 2. The probable phylogenetic relationships of the perennial species of Utah *Geranium*.

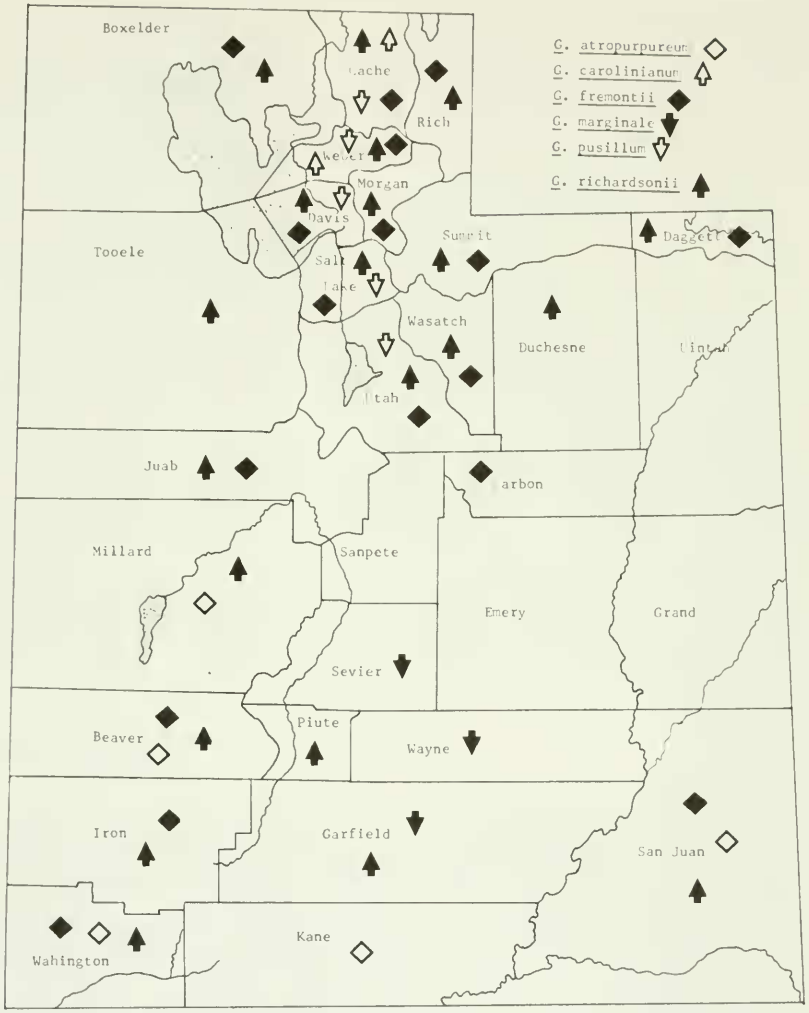

Fig. 3. Distribution of *Geranium* in Utah.

Harrison 7543 (BRY). Univ. St. and 1st. So., Salt Lake Co., WSF 729 (UT). Along Provo River, Utah Co., Sanders sn (UT). Near Salt Lake City, Salt Lake Co., Garrett 1766 (UT). Above Pelican Pond, Cache Co., Thieret 149 (UTC). Green Canyon, Cache Co., Shaw 36 (UTC). Logan, Cache Co., Smith 17669 (UTC).

2. *G. carolinianum* L. Sp. Pl. 682 (1753)

G. bicknellii Britt. var. longipes (Wats.) Fern.

Annual; stems 17-40 cm long, erect or branching at the base, short pubescence; leaf blades 2.5-7 cm wide, orbicular to reniform, 5-7

palmately parted; inflorescence very compact; sepals 6-8 mm long, tipped with awn 1-2 mm long; petals about as long as sepals, pink to whitish; 10 fertile stamens; style column 12-18 mm long with glandular hairs; carpel bodies 3-3.5 mm long; seeds reticulate. Open places and fields throughout North America. Type locality, Carolina. Antelope Island, Howard sn. (UT) Fern Hollow near Ogden, Weber Co., Cardon 313 (UTC)

"*Geranium carolinianum* has been confused with *G. bicknellii* Britt., the latter having been included in the Wasatch region by at least two authors. Inclusion of *G. bicknellii* in the flora might possibly have been based upon a collection from Logan Canyon in 1910 (C. P. Smith 2164). The stage of the plant's development makes it impossible to determine its true identity." (Shaw, 1952)

3. *G. atropurpureum* Heller Bull. Torr. Bot. Club 25:195 (1898)
G. caespitosum James ex Torr. apud Gray

Perennial; stems 10-90 cm long, erect sometimes becoming decumbent with age, retrorsely pubescent; basal leaves 2-6 cm wide, reniform to orbiculate, divided nearly to the base into 3-5 lobes, generally larger than the cauline leaves; inflorescence open and spreading; pedicels retrorsely pubescent but not glandular; sepals 9-11 mm long, awned; petals 10-15 mm long, pink to purple, pilose on petals ⅓-½ the petals' length, petals recurving; stylodia average 6.55 mm long. Often found growing in association with oak. Type from Santa Fe Creek, New Mexico (Heller 2723). (34 seen) Pine Valley, Wash. Co., Cottam 8905 (UT). Beaver Canyon, Beaver Co., Warnock sn (UT). Devils Canyon Campground, San Juan Co., Cottam 9523 (UT). Long Canyon above Orderville, Kane Co., Cottam 4279 (UT). 4 miles north of Glendale, Kane Co., VanCott 1002 (BRY). Sheba mine, Millard Co., Cottam and Biddulph 3200 (BRY).

"It was to this species that Gray assigned the name *G. caespitosum* (Gray 1849) believing it to be the species described by James. Material in the Gray Herbarium shows *G. atropurpureum* extending northward into the southern and southwestern counties of Colorado but not into the northeastern region where James is supposed to have collected his "caespitose" *Geranium* as pointed out by Heller (1898). Lacking collections from the general region or actual specimen collected by James, it seems advisable to follow Heller in calling this distinctly southern species *G. atropurpureum* and to consider *G. caespitosum* James ex Torr. a nomen dubium." (Moore, 1943)

4. *G. marginale* Rydb. ex Hanks and Small. N. Am. Fl. xxv 16 (1907)

Perennial; stems 10-30 cm long, retrorsely pubescent, slightly exceeding the basal leaves; leaves 2-3.5 cm wide, 5 parted; inflorescence not compact; pedicels retrorsely pubescent, not glandular; sepals 7-9 mm long, puberulent to nearly glabrous; petals purple, pilose ¼ the petal length; style column 1.5-2 cm long, stylodia average 4.33 mm long; carpel bodies 4 mm long; seeds 3 mm long, faintly reticulate. Type locality is the Aquarius Plateau at the head

of Poison Creek, Utah, Rydberg and E. C. Carlton 7401. (Hanks and Small, 1907).

This is probably the smallest of the perennial species found in Utah. Aquarius Plateau, 35 miles north of Escalante in Wayne Co. Holmgren, Reveal, and LaFrance 2080 (BRY). Aquarius Plateau, Garfield Co., VanCott 1196a (BRY). 2 miles north of Fishlake, Sevier Co., VanCott 933 (BRY). Bryce Canyon, Weight B-31/26 (UT). Wildcat Ranger Station, Garfield Co., Cottam 14130 (UT). Aquarius Plateau, Garfield Co., Cottam 9113 (UT).

5. *G. parryi* (Engelm.) Heller. Cat. N. Amer. Pl. ed. 2. 7 (1900)
G. pattersonii Rydb., *G. fremontii* var. *parryi* Engelm.

Perennial; stems 10-45 cm tall, glandular-pubescent throughout; petioles glandular; leaves 2-7 cm wide, deeply 3-5 parted; inflorescence open and spreading; pedicels glandular-pubescent; sepals 6-10 mm long; petals 12-15 mm long, purple, pilose on petals ¼-⅓ their length; style column 1.5-3 cm long, glandular, stylodia average 5.23 mm long; carpels 4-5 mm long; seeds 3-3.5 mm long, reticulate. No specimens of this plant have been seen from the state, but it should be looked for in the Uinta Mountains and in other parts of eastern Utah.

Another completely glandular species with which this species may be confused is *G. viscosissimum*. The distinctive characteristic separating them is the compact inflorescence of *G. viscosissimum*.

6. *G. richardsonii* Fisch. & Trautv. Ind. Sem. Hort. Petrop. 4:37 (1837)
G. gracilentum Greene, *G. albiflorum* sensu Hooker, *G. pentagynum* Engelm., *G. loloense* St. John.

Perennial; stems 30-90 cm tall, glabrous to pubescent; petioles long; leaves 3-15 cm wide, deeply 3-5 parted; inflorescence open; pedicels glandular-pubescent, glands usually purple; sepals 6-12 mm long; petals 1.5-2 cm long, white sometimes bluish, pilose ⅓-½ the petals' length; style column 2-2.5 cm long, glandular, stylodia average 4.06 mm long; carpel bodies 2.5-4.5 mm long. Found in partial shade or in rather moist ground.

(36 seen) 3 miles north of Roosevelt, Duchesne Co., Hardy 113 (BRY). Pine Valley Campground, Pine Valley Mts., Washington Co., Higgins 3454 (BRY). Cedar Mountain near Navajo Lake, Iron Co., Higgins 4666 (BRY). East of Kamas 1 mile above Upper Falls, Summit Co., VanCott 967 (BRY). ¾ mile west of Puffer Lake, Beaver Co., VanCott 904 (BRY). 10 miles west of Monte Cristo, Cache Co., VanCott 898 (BRY). Aspen Grove, Utah Co., Hardy 87 (BRY). Vernon, Tooele Co., Frischknecht 106 (BRY). Skyline drive east of Sterling, Sanpete Co., VanCott 943 (BRY). Kigalia Ranger Station, San Juan Co., WDS sn (UT). Deep Creek Mts., Juab Co., Lindsay 265 (UT).

7. *G. fremontii* Torr. ex Gray. Pl. Fendl. 26 (1849)
G. caespitosum sensu Rydb., *G. furcatum* sensu Hanks & Small

Perennial; stems 20-70 cm long, glabrous to pubescent, not glan-

dular; petioles long on northern plants shorter in southern specimens; leaves 3-10 cm wide, 5-7 parted, cauline leaves much smaller; inflorescence open, spreading; pedicels glandular-pubescent; sepals 7-12 mm long; petals 1-1.5 cm long, purple, pilose ¼-⅓ their length; style column 2.5-3 cm long, stylodia average 5.23 mm long; carpel bodies 4-5 mm long. Open areas of the foothills and mountains.

(49 seen) 4 miles east of Logan, Cache Co., VanCott 886 (BRY). Alpine Loop, Wasatch Co., Mullins 17 (BRY). South shore of Pineview, Weber Co., VanCott 896 (BRY). 4 miles west of Garden City, Rich Co., VanCott 885 (BRY). Near Cedar Breaks, Iron Co., Higgins 4643 (BRY). Pole Canyon, Utah Co., Hartman 127 (BRY). Tanners Flat, Little Cottonwood Canyon, Salt Lake Co., Day 30 (BRY). 13 air miles south of Wah Wah summit, Beaver Co., Holmgren and Bethers 3824 (BRY). Devils Canyon Campground, San Juan Co., Cottam 9523 (UT). Pine Valley, Washington Co., Cottam 8905 (UT). Beaver Canyon, Beaver Co., Warnock sn (UT). 15 miles NW of Orderville, Kane Co., Maguire 18821 (UTC).

This species is often confused with *G. nervosum*, which grows north of Utah. The difference between the two is in the inflorescence: *G. nervosum* has a compact inflorescence, and *G. fremontii* has a spreading inflorescence.

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